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SOME REMARKS ON THE INFLUENCE OF INSECTS ON HUMAN WELFARE*

Exd.

BY CARL D. DUNCAN

Professor of Entomology and Botany, San Jose State College

The ways in which insects affect human welfare are so numerous and diverse that no approach to completeness of treatment can be made in a brief paper. In the present instance, however, completeness is not needed, nor in fact is even a comprehensive sampling. A consideration of certain aspects of the subject will suffice, for the object of the paper is to advance the thesis that the time has come for entomologists to present to the public on whose support the progress of entomological research almost entirely depends a more balanced interpretation of insect and human relations than that usually current.

The subject of insects and human welfare is not new and certain aspects of it have been developed at length in a great variety of books, technical bulletins, magazine articles, newspaper stories and even reports over the radio. The relationships that have been most frequently stressed, perhaps naturally enough, have been those in which insects appear as enemies of man. It is not my desire to minimize the damage inflicted on man by those insects which are agricultural or forest pests, transmitters of disease, or are in other ways inimical to man's well being. Such damages, however, and the insects responsible for them, should be viewed in proper perspective. In no other way can the real importance of insects as a whole be understood correctly and evaluated properly.

It has long been apparent to biologists, whenever insect and human relations are viewed in their entirety, that the insect species which are injurious or antagonistic to human welfare actually constitute only a small proportion of the total of insect

*Presidential address read before the Pacific Coast Entomological Society, January 4, 1947.

life and that the great majority of insects are either directly or indirectly beneficial to man or enjoy a neutral status. Dr. Frank Lutz(8) has estimated that not more than one-half of one per cent of all the insects in the United States are actually pests. Calling attention to Lutz's estimate, Paul Knight(7) states that "those who care to extend the argument can show that a far greater percentage are of direct value, but that would prolong a question that is scarceley debatable." Nevertheless the beneficial aspects of insect activities have not been brought clearly to the attention of people generally.

It is still too common practice on the part of entomologists, and in particular of economic entomologists, since they must perforce focus their attention on destructive species, to ignore or to minimize the numerous benefits conferred on man by insects. For example, Graham, in "Principles of Forest Entomology,"(6) recognizes the beneficial role of numerous forest insects, but dismisses them with a paragraph of brief consideration in the final chapter. An occasional text, such as "Destructive and Useful Insects," by Metcalf and Flint(9) devotes a full chapter to the benefits that man derives from insects, and a very few treat the subject at more length, but in the majority of texts the treatment is quite inadequate.

All too often, especially in articles designed for popular consumption, we encounter extravagant statements and overdrawn pictures concerning the so-called warfare between man and the insects as if the two were engaged in a relentless struggle to the death. The "insect menace" has become a catch phrase. To be sure, most of these fantastic pictures are found in articles written by persons lacking entomological training. Not a few, however, have been prepared by entomologists who should know better and nearly all are based on information and ideas that have been supplied by entomologists. An unfortunate consequence of this state of affairs is that many, if not most, laymen have developed the belief that nearly all insects are injurious and should ruthlessly be exterminated.

A few decades ago excessive emphasis on the destructive activities of insects perhaps was justified. The increasing number of insect pests required that public attention be directed to these enemies of agriculture. Without this emphasis it might not have been possible to arouse the public sentiment and the legislative

backing that were essential for the support of needed research on pest control. At that time also a factual basis for an adequate appreciation of the beneficial aspects of insect life had not yet been sufficiently developed. For that matter, there is real need at the present time for extensive and detailed exploration of the beneficial activities of insects. In particular there is a need for quantitative studies. The knowledge we now possess is mostly of a qualitative nature.

The goal of an aroused public interest in the study of injurious insects has long since largely been achieved and adequate support for research in economic entomology usually is available. We now urgently need to round out the picture, to educate the lay public to a realization of the vast amount of good that is done by insects as a whole, to the end that balanced judgment shall determine the general attitude toward insect-human relations and that all branches of entomological research shall be recognized as meriting adequate support.

There is at present a measure of real danger that the lay public, animated by the conviction that insects constitute an enemy group, may attempt to carry the matter of insect control, or rather, suppression, too far. For the first time in the history of man's conflict with insects the materials at his disposal make the unwise dream of insect extermination seem possible of attainment, at least in localized areas; or if this state of affairs has not yet been attained, at least it seems to be not far away. If, therefore, man is to be spared costly experiences in which his actions bring down upon him more harm than good, it is essential that there be developed in the public mind an appreciation of the beneficial activities of insects that will serve to balance the already well developed appreciation of their injurious activities.

The economic entomologist has a special responsibility in this connection because of his frequent contacts with a segment of the public which has a special reason for distrust of insects. Moreover, to ensure the proper development of economic entomology in the years that lie ahead, it is essential that the economic entomologist recognize and accept this responsibility as many of them individually already have done. It is becoming increasingly evident that the carrying out of proper measures for the control of injurious insects is not simply a matter of applying a sufficiently lethal insecticide. Rather it requires that each species

be regarded in the light of the entire complex ecological picture of which it is a part and that control measures be selected accordingly. It often happens that insects that are injurious under one set of conditions or circumstances are of no consequence or are beneficial under others. A correct appraisal of the economic status of many an insect, therefore, can not be made by the farmer but only by a well trained economic entomologist who has a broad knowledge of general insect ecology. A great deal of time and money is now wasted in so-called "insurance spraying" which might be saved or better used in some other type of control. The farmer should be educated to expect the economic entomologist to have the broad type of training suggested above and to look confidently to the economic entomologist for immediate advice and guidance in meeting his problems of pest control. This desirable relationship cannot materialize so long as the current point of view continues to prevail.

It may be that the danger that I have envisioned is more apparent than real. Human affairs move with sufficient slowness that the unwisdom of attempts at the wholesale extermination of insects may be made sufficiently clear through repercussions from early attempts that efforts in this direction will be abandoned and will be replaced by actions based on a saner philosophy. Certainly the usage of DDT to date has revealed that such powerful insecticides, valuable as they are, cannot be used indiscriminately with impunity. Nevertheless much is to be gained by a concerted program of public education that is aimed at balanced enlightenment in place of the present program of merely seeking support for more and ever more destruction of insect life.

In the light of the reasoning thus far advanced it seems worthwhile to review certain of the interrelations between man and insects in which the insects play a beneficial role.

As a general rule little attention is paid to the factors concerned in the control of the plant population of the earth and the place that insects hold among these factors. Because of man's dependence on plants it is customary to label as injurious any creature aside from man and his domestic animals that feeds on plant life. Yet obviously this is not the case. An organism is really injurious only when it becomes sufficiently abundant that its activities are genuinely detrimental to the welfare of other

organisms. This happens in the case of only a very small proportion of insects. Moreover, it is possible for a plant as well as an insect or other animal to get out of balance with the rest of life; to become, in fact, a pest. A few plants in recent decades have so far escaped from normal population controls as to become veritable scourges, and so far, the only significant progress in bringing them back under control has been accomplished through the use of insects that feed on them.

The most notable example is the prickly-pear cactus in Australia which according to some authorities by 1935 occupied some 60,000,000 acres of Australian soil to the extent that it was practically worthless for agriculture. Cactus feeding insects introduced from the Americas have brought the cactus under control. Most of the work of control has been wrought by a single species, the moth *Cactoblastis cactorum*, whose caterpillar mines the joints of the cactus. Allan P. Dodd(4) says the introduction of this insect between 1925 and 1927 "brought a complete change in the outlook within a few years. Its progress has been spectacular, its achievements border on the miraculous. Great tracts of country, utterly useless on account of the dense growth of the weed, have been brought into production. The prickly pear territory has been transformed from a wilderness to a scene of prosperous endeavor."

Probably not many plants possess the qualifications for becoming pests of the magnitude of the cactus but we have no way of judging beforehand. There are other weed plants besides cactus which, though perhaps less objectionable, have nevertheless become major pests in countries into which they have been introduced. Such are lantana in Hawaii and Australia, blackberry and gorse in New Zealand, and St. John's Wort in California. Success has been only partially attained to date in controlling these weeds but the measure of success that has been attained has been accomplished largely through the use of insects.

In the countries to which they are native these plants are not pests. They fit normally into the flora of those regions in mutual adjustment with other organisms. The factors that determine their normal population levels, as is true of plants everywhere, undoubtedly are several but among these are the insects that feed upon them. Dr. Brues has pointed out in "Insect Dietary" that insects are a major factor in determining population

levels in plant life. We perhaps cannot even guess accurately what the consequences would be if insects were to be totally removed from the realm of plant life but we can be sure that it would be some sort of chaos and that man would be numbered among the victims of such a disastrous happening.

We are accustomed to looking upon insects that attack trees as injurious and requiring control, and certainly often, though not always, this view is the correct one. Yet it is equally certain that the majority of insects to be found in a forest are not detrimental to the forest and that many, if not the majority, actually benefit the forest in one way or another. F. C. Craighead(2) in "An Annotated List of the Important North American Forest Insects" lists less than 200 kinds of really destructive species distributed over many families, yet W. J. Chamberlin(1) records 575 species of bark and timber beetles in but two families. The great majority of these are forest species but the great majority are not destructive.

Chamberlin (l.c.) says, "When *Micracis, Carphoborus, Pityophthorus, Pityokteines, Lymantor, Hypothenemus,* or any of the other similar species attack the lower limbs of trees and kill them, they are but hastening natural pruning which results in a clean bole and a better grade of lumber."

Doane, Van Dyke, Chamberlin, and Burke(3) say that "In every heavily stocked young forest there are thousands of trees that must die and pass out of the picture before the forest reaches maturity. . . . . Nature takes care of this . . . . . need through suppression of slower-growing trees; and at times insects and disease may serve a useful purpose in removing trees from overcrowded stands, thereby releasing the space to the surviving trees which will then grow more rapidly and into better wood material."

It is obvious, therefore, that without the beneficial services of numerous forest insects our forests would never have attained to their present magnificence, their productivity would be far less than it now is, lumber would be inferior, they would be less suitable as homes for valuable wild life and their esthetic and recreational values would be far less than they now are. They would, moreover, be filled with a tangled maze of dead branches and small trees that would constitute a fire hazard far greater than any now known, or what is more probable, they would be swept by destructive fires of such extent and with such frequency

as never to attain the status of forest maturity as we now know it.

To consider another phase of the general problem, many insects inhabit the soil, often in tremendous numbers. In one case in Illinois their numbers were estimated at no less than 65 millions per acre. Some of the soil insects, namely wireworms, white grubs, certain aphids and mealybugs, and a miscellany of others, feed on the underground parts of plants, damaging them more or less, and at times attain the status of pests. The majority, on the other hand, make a definite, important, and perhaps essential, contribution to the development of the soil itself and to the maintenance of soil fertility.

Paul Knight(7) in this connection says, "(1) Soil organisms cause a continual interchange of soil particles by bringing to the surface particles of subsoil. The gradual enrichment of these subsoil particles increases the thickness of the rich top layer. (2) The burrows of soil organisms allow better drainage and aeration. (3) The dead bodies of animals such as insects and worms add a large amount of organic material to the earth. (4) The excreta of insects compares favorably in fertilizing value with the digestive wastes of other animals. Though the digestive waste of one insect is infinitesimal, the aggregate mass of all insect excreta probably exceeds that of the larger animals and is an important factor in soil fertility."

W. M. Wheeler(10), referring specifically to the soil building activities of ants says "Thus the ants act on the soil like the earthworms, and this action is by no means inconsiderable, although as yet no one has studied it in detail."

In the discussion of both of the preceding two topics—forest insects and soil inhabiting insects—mention has been made of the effectiveness of insects as scavengers. Their value in this connection can more easily be underestimated than overestimated for they are second in importance only to the bacteria and fungi as agents of decay.

We deplore decay whenever it affects any type of material or product that we wish to preserve for a time. We deplore the existence of Penicillium fungi that destroy a part of the oranges or lemons that we buy in the markets, we strive to prevent the growth of the several rot disease fungi that destroy the foundation timbers of our homes and other buildings; we abhor the maggots that swarm through the carcass of a dead animal or a mass of

garbage that has not been properly disposed of, but at the same time we recognize the general usefulness of decay. We know that decay is the necessary counterpart to life and without decay life would soon become impossible on the earth.

Folsom and Wardle(5) say that insects "As scavengers are of inestimable benefit, consuming as they do in incalcuable quantity all kinds of dead and decaying animal and vegetable matter. This function of insects is most noticeable in the tropics, where the ants, in particular, eradicate tons of decomposing matter that man lazily neglects."

The importance of decay and the necessity for it lies in the fact that certain chemical elements, in particular nitrogen, phosphorus, and potassium, obtained from the soil by plants and needed alike by plants and animals are present in usable form only in relatively small amounts in most soils. The available supply must be returned to the soil on the death of the organisms living on or in the soil if life is to be continued in anything like its normal luxuriance. Without the beneficial agency of the bacteria, fungi, insects, and other organisms of decay but especially these three, developing plant life would gradually but surely tie up in plant tissues almost all of the existing supply of critically needed mineral elements.

For the purpose at hand it is unnecessary to develop in detail additional aspects of the general topic. Simple mention or very brief treatment of some of these will suffice. All, in one way or another, are fairly well known to entomologists though not to the general public, or at least not sufficiently known.

The importance of insects as animal foods is apparent when we realize that considerably more than half of the food supply of common land birds, fresh water fishes, many reptiles, and many small mammals consists of insects and without the insects these animals would be unable to maintain themselves. It is customary to consider such animals as constituting checks on the increase of insects, and no doubt at times and perhaps continuously to a limited extent they do constitute such checks, but there is much evidence to indicate that more often the vertebrates in question, and in particular the birds, are merely living off of the surplus of insect life and are not a significant factor in regulating insect abundance.

The dependence of flowering plants on insects as pollen

carriers has received wide attention. It is estimated that about 85% of flowering plants require insect pollination in whole or in part. Metcalf and Flint(9) estimate that the annual yield of agricultural crop plants in the U.S. that depend on pollen transfer by insects has a value in excess of two billions of dollars. In this field as in others, however, the picture that has commonly been drawn is an unbalanced one. Most discussions of the subject have been in terms of the honey bee and bumble bees. Admitting the tremendous importance of these insects, it must yet be recognized that there are thousands of species of plants for which the honey bee and bumble have no meaning. Great numbers of other insect species: solitary bees, flies, beetles, moths and butterflies, and even, occasionally, such small creatures as thrips, function as pollinators of these plants and in numerous instances play an absolutely essential role. Without them a considerable proportion of our garden flowers and shrubs could not exist, nor could there be the wealth of color and variety in the wild plants that clothe our valleys and hillsides in proper season. Insects, therefore, make a contribution to the esthetic and recreational resources of man that is not inconsiderable.

Much of the vegetation that adds beauty to the desert areas of the earth consists of insect pollinated plants. Such also is the case with the chaparral and other growths that hold back the run off on hillsides and gentler slopes over vast acreages and so protect the lowlands from destructive floods.

In summation, it is perhaps impossible to visualize adequately the totality of beneficial effects which insects exert directly or indirectly on human welfare, but the benefits are incalculably great. It is not too much to say that insects determine the character of man's world to a far greater extent than he does himself and that if they were suddenly to disapper completely the world would be changed so extensively that it is extremely doubtful that man would be able to maintain any sort of organized society whatever.

I repeat, therefore, that the time has come for entomologists generally, and for economic entomologists in particular, to present to a public that is manifesting increasing interest in insect life, a more rounded and better balanced picture of insect life. It is time to appeal for interest and support on the basis of this more complete picture and man's place in it, recognizing that

all forms of life are interwoven in an integrated whole which needs to be understood before it can safely be changed in any radical manner, and that in arriving at this more intelligent basis for orienting ourselves to the insects there is no place for categorical condemnation or praise. On the contrary, each species or closely knit group deserves to be considered independently and judged on its individual merits.

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DESCRIPTION OF THE LARVA OF PLEOCOMA HIRTICOLLIS VANDYKEI LINSLEY

(Coleoptera, Scarabaeidae)[1]

BY P. O. RITCHER

Kentucky Agricultural Experiment Station, Lexington

Much has been written about the adults of the peculiar genus *Pleocoma* and their habits, but little has been published about their larval stage. Osten-Sacken in 1874 described a *Pleocoma* larva found deep in the earth by Mr. Behrens of San Francisco. The only other reference to the morphology of larvae of the genus is by Böving and Craighead (1930-31) in their key to families and subfamilies of the Scarabaeoidea.

Early in 1946, while visiting at the University of California, in Berkeley, the writer was shown 8 *Pleocoma* larvae collected February 26 by R. F. Smith and J. W. MacSwain from a spot near Patterson Pass where *Pleocoma hirticollis vandykei* Linsley had been found abundant previously (Smith and Potts, 1945). A second trip to the same spot, March 8, 1946, by Smith, MacSwain, several of Linsley's graduate students, and the writer, yielded over 40 additional larvae. They were found from 1 to 3 inches deep in the pasture soil feeding on grass roots.

Besides the larva of *Pleocoma hirticollis vandykei* Linsley, described in this paper, the larvae of *Pleocoma australis* Fall, *Pleocoma badia* Fall, *Pleocoma fimbriata* Le Conte and a larva of an unknown species from Sacramento, California, have been examined by the writer, through the courtesy of Dr. Linsley and the U. S. National Museum. All of these agree in the following essential characters: antenna 3-segmented; epipharynx with tormae not united mesally; haptomerum with a group of heli; chaetoparia well-developed; plegmatia present; hypopharynx without oncyli; terga of abdominal segments 3 to 7, inclusive, with 4 dorsal annulets; spiracles with concavities of respiratory plates facing ventrally; legs 4-segmented; mesothoracic and metathoracic legs with stridulating organs; anal opening Y-shaped, not surrounded by fleshy lobes.

[1]The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

Like the adults, *Pleocoma* larvae resemble geotrupids in several important morphological features. Of all the Scarabaeidae, only larvae of *Pleocoma* and those of geotrupids have 3-segmented antennae. Too, the stridulating organs found on the legs of *Pleocoma* larvae are very similar to those of *Geotrupes* and *Odontaeus*. In contrast, however, the epipharynx, the tergal annulets of the abdominal segments, and the last abdominal segment of *Pleocoma* are entirely different from homologous structures of known geotrupid larvae and, in fact, resemble in many ways structures characteristic of melolonthine larvae. Because of these important differences, the writer would prefer placing the genus *Pleocoma* in a subfamily close to, but distinct from, the Geotrupinae, as Leng (1920) has done, rather than class *Pleocoma* with the geotrupids (Paulian, 1941).

Third-stage Larva of Pleocoma hirticollis vandykei Linsley

Description based upon a study of 9 third-stage larvae and a cast skin of a larva found associated with a dead male in its pupal cell. Male identified by Linsley.

Larva (Fig. 1) typically scarabaeiform with whitish body and light yellow-brown head. Length of mature larva ranging from about 45 to 50 mm.

Cranium (Fig. 4) narrower than prothorax. Surface shining and generally smooth with a series of fine longitudinal striae on each side of the epicranial suture (ES). Maximum width of cranium ranging from 6.5 to 9 mm. with a mean of 8 mm. Frontal sutures (FS) whitish and sinuate, forming less than a right angle at their juncture with the epicranial suture. Frons (F) bearing on each side an irregular, transverse row of 5 to 10 posterior frontal setae (PFS), one large seta (AA) in each anterior angle (rarely with an additional small seta), a single large exterior frontal seta (EFS) (often with 1 or 2 small setae), and a single large anterior frontal seta (AF) (plus 2 to 4 small setae). Epicranium (E) with 2 large dorsoepicranial setae on each side of the epicranial suture. Ocelli absent.

Clypeus (Fig. 4) trapezoidal with slightly concave lateral margins; divided transversely into a large, rather heavily sclerotized postclypeus (PSC) and a very small, membraneous preclypeus (PC). Postclypeus on each side with a transverse patch

of setae consisting of 3 large setae and several small setae, anteriorly with an irregular series of low longitudinal rugosities.

Labrum (L, Fig. 4) slightly wider than long, symmetrical and apically trilobed. Surface bearing numerous long setae and, except for the apical membraneous lobes, rather heavily sclerotized and coarsely reticulate.

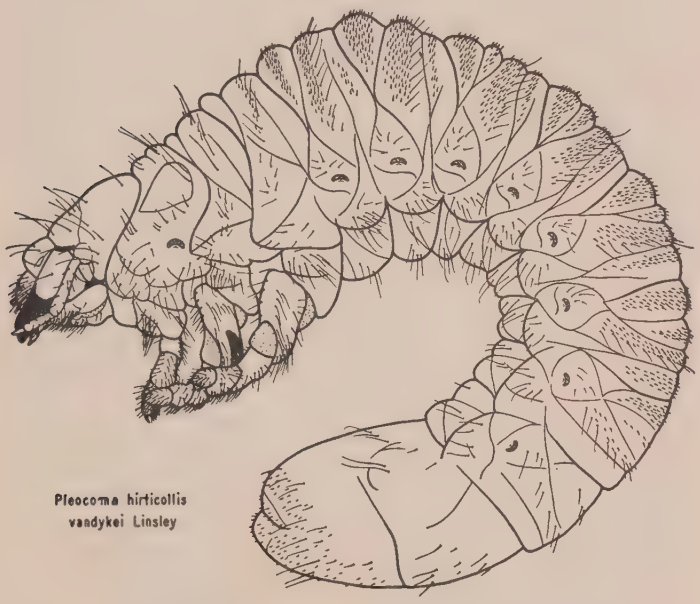
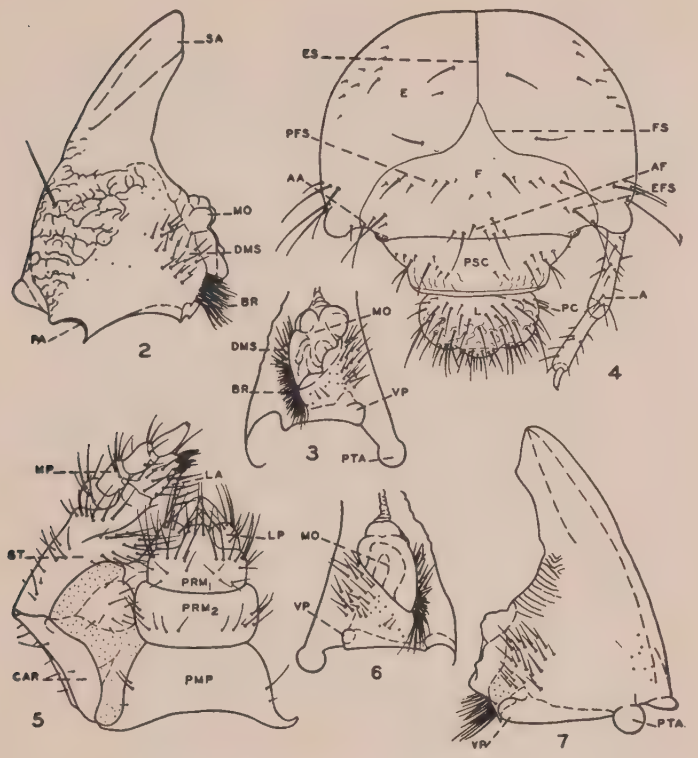


Fig. 1. Third-stage larva of *Pleocoma hirticollis vandykei* Linsley. Left lateral view. 10X.

Antenna (A, Fig. 4) almost as long as cranium, fairly slender, 3-jointed, and borne on a cylindrical basal piece fused to the epicranium. First segment as long as second and third segments together; third segment very small, about one-third as long and half as wide as second segment. First and second segments bearing numerous setae. End of second antennal segment, below juncture with apical segment, with a small oval sensory spot. Apical segment without sensory spots; apex with 2 to 4 olfactory pegs.

Mandibles (Figs. 2, 3, 6 and 7) shorter than cranium, approximately symmetrical, subtriangular in outline, each with a strong, blade-like scissorial area (SA) and a rather small, molar area (MO). Scissorial area blackish with a slightly concave or nearly straight cutting edge. Molar areas also blackish, those of left and right mandibles similar in size but somewhat asymmetrical. Molar area of right mandible (Fig. 6) with a transverse apical lobe and a curved median lobe, the latter surrounding a small, longitudinal proximal lobe. At the base of each molar area is a dense brush of setae or brustia (BR). On the dorsal surface of each mandible, laterad of each molar area, is a patch of 27 to 30 setae, the dorsomolar setae (DMS). Dorsoexterior mandibular region and lateral face of mandible much wrinkled, not separated by a scrobis. Lateral face with a single, large, median seta. Ventral surface of each mandible transversely wrinkled between the inner proximal part of the scissorial area and the molar area. Laterad of the molar area and extending to the vicinity of the small ventral mandibular process (VP) is a large patch of 29 to 33 setae. The region mesad of the ventral mandibular process bears a number of pores and sometimes 1 to 3 setae.

Maxilla (Figs. 5 and 8) consisting of a cardo, stipes, galea, lacinia and a maxillary palpus. Cardo (CAR) subquadrate in outline and extending from the base of the maxilla to the proximal edge of the stipes. Cardo divided longitudinally into 2 oblong sclerites, the dorsal one bearing a few scattered setae. Stipes (ST) bounded posteriorly by the cardo and anteriorly by the maxillary palpus and galea. Dorsally, along the inner edge of the stipes, is a row of 10 to 16 conical, stridulating teeth (SD). Ventrally, the stipes bears a number of long needle-like setae; and a narrow, transverse, irregular double row of similar setae adjoins the maxillary palpus. Galea and lacinia distinctly separate but lying close together. Galea (G) with a single apical uncus (UN), bordered dorsally by 4 stout setae and ventrally by 2 stout setae; remainder of surface with a sparse covering of slender setae. Lacinia (LA), with a terminal uncus having 1 or 2 ventral tooth-like lobes. Inner edge of lacinia bearing 2 rows of long stout setae, the dorsal row extending from the uncus to the proximal margin of the lacinia. Dorsad and ventrad of the rows of stout seta the lacinia is sparsely covered with slender setae. Maxillary palpus 4-jointed, the first 3 joints bordered an-



PLEOCOMA HIRTICOLLIS VANDYKEI LINSLEY

Fig. 2. Left mandible, dorsal view. Fig. 3. Molar region of left mandible, ental view. Fig. 4. Head, cephalic view. Fig. 5. Right maxilla and labrum, ventral view. Fig. 6. Molar region of right mandible, ental view. Fig. 7. Left mandible, ventral view.

Abbreviations: A—Antenna. AA—Seta of anterior frontal angle. AF—Anterior frontal setae. BR—Brustia. CAR—Cardo. DMS—Dorsomolar setae. E—Epicranium. EFS—Exterior frontal setae. ES—Epicranial suture. F—Frons. FS—Frontal suture. L—Labrum. LA—Lacinia. LP—Labial palpus. MO—Molar area. MP—Maxillary palpus. PA—Preartis. PC—Preclypeus. PFS—Posterior frontal setae. PMP—Postmentum. PRM—Prementum. PSC—Postclypeus. PTA—Postartis. SA—Scissorial area. ST—Stipes. VP—Ventral process.

teriorly by a semi-circle of setae. Apical joint with a lateral, sensorial groove and a number of distal, sensory pegs.

Labium (Figs. 5 and 9) composed ventrally of a subtrapezoidal postmentum (PMP), the subdivided prementum (PRM_1 and PRM_2) and a pair of labial palpi (LP). Postmentum bare except for a few setae near each lateral margin. Proximal sclerite of prementum subquadrate in outline, wider than long, set with a transverse row of setae interrupted mesally. Apical sclerite of prementum set with numerous setae, of which the largest are those adjacent to the bases of the labial palpi. Dorsal surface of apical sclerite of prementum, called the glossa (GL), with a dense covering of long slender setae, anteriorly and on each side. Central posterior portion of glossa sparsely set with short, stout, conical setae. Labial palpi 2-segmented.

Hypopharynx Fig. 9, (HP) located posterior to the glossa and dorsad of the proximal sclerite of the prementum. Hypopharynx, on each side with a caudal sclerotized shoulder (LL) behind which is the point of contact with the ventral process of the adjacent mandible. Oncyli (the protruding, sclerotized hypopharyngeal process or processes present in most scarab larvae) absent.

Epipharynx (Fig. 12) symmetrical, slightly broader than long with rounded lateral margins, trilobed apically. Apical lobe, or corypha (CO), set with coarse setae and bounded on each side by a clithrum (CLI). Plegmatia present, each plegmatium (PL) consisting of about 11 to 15 semi-circular, sclerotized plegmata, each plegma surrounding the base of a coarse acanthoparial seta. Proplegmatia absent. Chaetoparia (CPA) large, separated from the acanthoparia by a narrow gymnoparia (GP). Each chaetoparia consisting of a dense patch of sharp setae not interspersed with sensilla. Chaeta stoutest toward the pedium (PE). Haptomerum (H) bearing a rather sparsely set, semi-circular group of 9 to 12 large, stout heli (HE). Anterior to the bases of most of the heli is a single large sensillum. Tormae rather indistinct, symmetrical, not branched, not meeting mesally. Haptolachus (HL) incomplete, nesia absent. Caudomesad of the inner end of the dexiotorma (DX) and the pternotorma (PTT) is a longitudinal curved phoba (PH). The area laterad of each phoba has 20 to 30 crepidial punctures CP). Four macrosensilla (MS) are found between the caudal ends of the phobae. Posterior to the phobae is the curved, transverse crepis (CR).

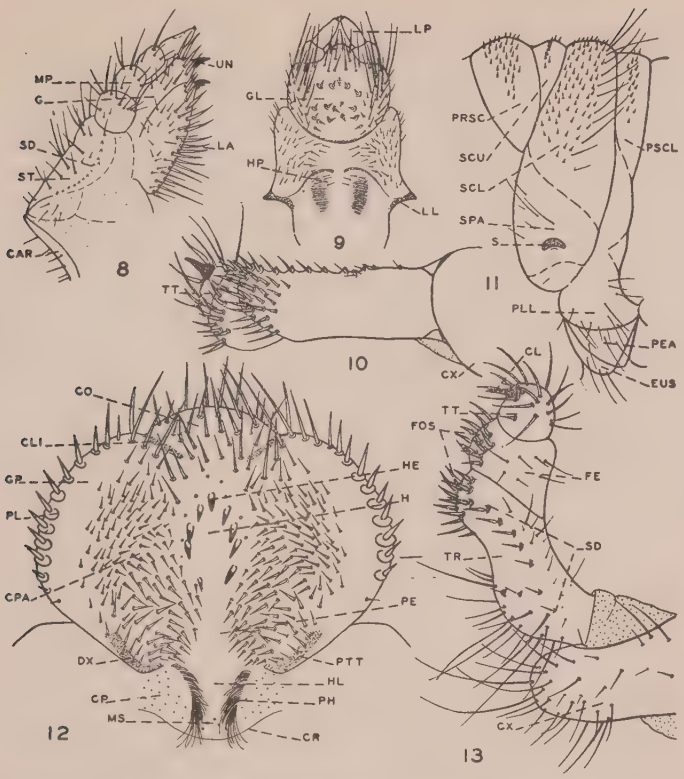


Fig. 8. Left maxilla, dorsal view. Fig. 9. Labium and hypopharynx, dorsal view. Fig. 10. Distal portion of right, metathoracic leg, ventral view. Fig. 11. Third abdominal segment, left lateral view. Fig. 12. Epipharynx. Fig. 13. Right metathoracic leg, lateral view.

Abbreviations: CAR—Cardo. CL—Claw. CLI—Clithrum. CO—Corpyha. CP—Crepidial punctures. CPA—Chaetoparia. CR—Crepis. CX—Coxa. DX— Dexiotorma. EUS—Eusternum. FE—Femur. FOS—Fossorial setae. G—Galea. GL—Glossa. GP—Gymnoparia. H—Haptomerum. HE—Helus. HL—Haptolachus. HP—Hypopharynx. LA—Lacinia. LL—Lateral lobe. LP—Labial palpus. MP—Maxillary palpus. MS—Macrosensilla. PE—Pedium. PEA—Pedal area. Ph—Phoba. PL—Plegma. PLL—Pleural lobe. PRSC—Prescutum. PSCL—Postscutellum. PTT—Pternotorma. S—Spiracle. SCL—Scutellum. SCU—Scutum. SD—Stridulating teeth. SPA—Spiracular area. ST—Stipes. TR—Trochanter. TT—Tibiotarsus. UN—Uncus.

Legs (Figs. 1, 10 and 13) well developed with the prothoracic shorter than the mesothoracic pair and the mesothoracic shorter than the metathoracic pair. Each leg 4-jointed, consisting of a fairly long, stout subcylindrical coxa (CX), a slightly shorter trochanter (TR), a short femur (FE) and a short tibiotarsus (TT) which bears a terminal claw (CL). Mesothoracic and metathoracic legs with stridulating organs, these consisting of a finely striated area on the posterior surface of the mesothoracic coxa and a V-shaped row of about 12 sclerotized teeth (SD), each tooth at the base of a seta, on the anterior surface of the metathoracic trochanter. Anterior ventral surface of meso- and metathoracic trochanters and ventral surface of meso- and metathoracic femora densely set with stout spine-like setae (FOS, Fig. 13) undoubtedly useful in burrowing through the hard soil. Claws simple, each consisting of a straw-colored base and a dark, slender, sharp, distal portion. Base of each claw with 2 setae. Prothoracic claws much longer than meso- and metathoracic claws.

Body (Fig. 1) consisting of 3 thoracic and 10 abdominal segments. Prothorax with 2 dorsal areas each with a single transverse row of slender setae. Mesothorax and metathorax each with 3 dorsal annulets, a prescutum, a scutum, and a scutellum. Scutum of mesothorax with a transverse row of slender setae; scutum of metathorax similarly clothed and, in addition, with an irregular, transverse, single or double row of short stout setae cephalad of the slender setae.

First and second abdominal segments each with 3 dorsal areas. Prescuta of each with a transverse band of short stout setae; that on the first abdominal segment 2 or 3 rows wide, that on second abdominal segment about 5 or 6 rows wide. Scuta each with a long transverse band of setae consisting anteriorly of about 5 irregular rows of short stout setae and posteriorly of a single sparsely set row of fairly long slender setae. Scutellum of first abdominal segment with a short sparsely set transverse patch of short, stout setae on each side and a bare, middorsal area. Scutellum of second abdominal segment with a long, narrow, transverse, single or double row of short, stout setae. Abdominal segments 3 (Fig. 11) to 7 inclusive each with 4 dorsal annulets, a prescutum, scutum, scutellum and postscutellum. Each prescutum bears a transverse patch of about 5 to 7 irregular rows of short, stout setae. Each scutum with a short, transverse, irregular, double

row of short, stout setae. Each scutellum has a long transverse band of short, stout setae posterior to which is a single sparsely set row of rather long slender setae. Each postscutellum (except that of abdominal segment 7 which is bare) with a long, transverse, irregular double or triple row of short, stout setae.

Dorsa of abdominal segments 8 and 9 not divided into distinct annulets. Each dorsum anteriorly with scattered slender setae and an occasional short, stout setae; posteriorly with a sparsely-set transverse row of long slender setae cephalad of which are a few scattered, short, stout setae. Dorsum of tenth abdominal segment with a transverse sinuate dorsal impressed line. Region

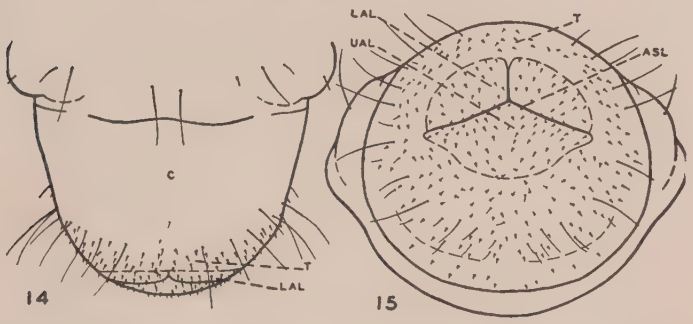


Fig. 14. Last abdominal segment, ventral view. Fig. 15. Last abdominal segment, caudal view.

Abbreviations. ASL—Anal slit. C—Campus. LAL—Lower anal lip. T—Teges. UAL—Upper anal lip.

between dorsal impressed line and anterior margin of abdominal segment 10 set with scattered short, stout setae. Dorsal area between upper anal lip (UAL, Fig. 15) and dorsal impressed line clothed with short, stout setae interspersed with long, slender setae.

Thoracic shield, located on each side of prothorax, rather inconspicuous, straw-colored, roughly triangular in outline. Spiracle-bearing areas (SPA, Fig. 11) of abdominal segments 1 to 8 each with 5 to 9 setae. Pleural lobes (PLL) of abdominal segments 1 to 8 each with a patch of 8 to 16 setae. Eusterna (EUS) of abdominal segments 1 to 7 each with a transverse row of 6 to 16 setae. Pedal areas (PEA) of same segments with 2 to 7 setae on each side.

Anal Slit (ASL, Fig. 15) Y-shaped, basal cleft short. Anus bordered dorsally by the triangular upper anal lip (UAL) and ventrally by the mesally cleft lower anal lip (LAL). Both anal lips covered with short, stout setae.

Raster (Figs. 14 and 15) consisting of a simple teges (T) in the form of a narrow transverse band of 50 to 70 short, stout, caudally directed setae, located cephalad of the lower anal lip. Cephalad of the teges, especially toward each side, are several long, slender setae. Anterior to these setae and the teges, the venter of the tenth abdominal segment is bare (C, Fig. 14).

Spiracles (Figs. 1 and 11) consisting of 1 pair of thoracic spiracles and 8 pairs of abdominal spiracles. Thoracic spiracles considerably larger than the abdominal spiracles which are alike in size. Respiratory plates of spiracles kidney-shaped, with their concavities facing ventrally. Spiracles cribiform but "holes" of respiratory plate rather opaque, not arranged in definite rows.

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TWO NEW SPECIES OF APANTELES FROM CALIFORNIA
(Hymenoptera: Braconidae)

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The following descriptions are presented at this time in order to provide names for use in connection with biological studies involving two new parasites.

Apanteles medicaginis Muesebeck, new species

Apanteles flaviconchae Riley[1] was originally described from Missouri and Connecticut and considered a possible parasite of the armyworm since the cocoons had been found in clover fields infested with that pest. It is now known to occur from Maine to Texas as a parasite of *Colias*. Although so wide a host range is unusual for a species of *Apanteles*, it appears that phalaenid larvae are also successfully parasitized on occasion by *flaviconchae*, for there are what seems to be authentic records of rearings from *Plathypena scabra* (F.), the green cloverworm. The principal host, however, is the pierid *Colias philodice philodice* Latr., the so-called clouded sulphur, the larva of which is a common and widespread clover pest. *A. flaviconchae* is a gregarious parasite, some 20 or more individuals developing within a single caterpillar.

Recently an *Apanteles*, parasitic on the alfalfa caterpillar, *Colias philodice eurytheme* Bdvl., has attracted attention in California; and several samples have been submitted to me for identification. This form agrees so closely with *flaviconchae*, except for the paler hind femora of the female, that I have been inclined to regard it as only a western race of *flaviconchae*. Dr. Ray F. Smith, of the University of California, now has informed me, however, that this parasite always develops singly in its host. It would appear, therefore, that despite the similarity in structure and host relations the eastern and western populations are distinct species. Accordingly, the California parasite of the alfalfa caterpillar is here described as new.

[1]Trans. Acad. Sci. St. Louis 4(2):308, 1881.

The only structural differences I have discovered between this species and *flaviconchae* are quantitative and subtle. They are not easily defined. In *medicaginis* the upper third of the face has a more or less distinct, median, longitudinal, keel-like elevation, of which there is only a faint suggestion in *flaviconchae*. The malar space in *medicaginis* is slightly longer and the face a little narrower than in *flaviconchae*, the face at its narrowest point being narrower than the eye height. In *flaviconchae* the punctures on the posterior half of the mesoscutum are separate although close, whereas in *medicaginis* they tend to be confluent, especially along the lines of the notaulices. The polished lateral margins of the second tergite are usually complete in *flaviconchae* and are continued upon the basal part of the third tergite, whereas in *medicaginis* they are usually not complete and seem never to extend upon the third tergite. Although these two species are not always readily separated by these distinctions, the females may normally be recognized at a glance. In *flaviconchae* the posterior femora are black in both sexes, but in *medicaginis* those of the female are reddish-yellow or, at the most, blackish along the upper and lower edges.

Female. Length about 2.5 mm. Face smooth and shining; malar space at least one and one-half times as long as clypeus. Punctures of mesonotum very small but sharp and close throughout, in places confluent as noted above, scutellum convex with scattered weak punctures, shining; propodeum rugose with a complete median longitudinal carina and strong though incomplete costulae; mesopleuron closely punctate on lower half and anteriorly, smooth and polished above the longitudinal impression. Stigma barely twice as long as broad; radius strongly inclined outwardly, longer than intercubitus and joining it in a definite angle; nervellus strongly oblique but nearly straight. Calcaria of hind tibia subequal, slightly less than half as long as metatarsus.

Abdomen rather stout; plate of first tergite broadening apically, finely rugulose; second tergite nearly three times as long as broad, much shorter than third, closely rugulose with very narrow lateral polished margins; suturiform articulation sharply impressed, minutely pitted; third tergite usually with a little indefinite sculpturing basally; hypopygium attaining apex of last tergite; ovipositor sheath barely exserted.

Black; maxillary palpae yellowish except toward base; labial palpae usually piceous, tegulae and radices black; stigma dark brown, most of the veins pale; legs reddish yellow with all coxae and trochanters, bases of fore and middle femora, apices of hind femora and of hind tibiae, and the posterior tarsi, blackish.

Male. Like the female but with black hind femora.

Type locality. Dos Palos, Merced County, California.

Type. United States National Museum No. 58213.

Described from 94 specimens from the type locality, reared from *Colias philodice eurytheme* Bdvl. in August 1946, by Ray F. Smith. In addition to the type series I have before me specimens of this species from Berkeley, Tracy, Westley, Hemet, and Sacramento, California, reared from *C. philodice eurytheme* or collected in alfalfa fields.

Apanteles praesens Muesebeck, new species

This species, which was discovered by N. L. H. Krauss in southern California as a parasite of the geometrid *Anacamptodes fragilaria* (Grossb.), has been taken to Hawaii to combat that pest, which recently became established there. It very closely resembles *A. caffreyi* Mues., but may be distinguished by its more strongly punctate head, conspicuously longer calcaria of hind tibiae, and darker posterior legs.

Female. Length 2.5 mm. Head dull; face, vertex, and temples closely punctate; ocellocular line less than twice the diameter of an ocellus; temples receding; antenna a little longer than body. Mesoscutum mat covered with closely placed but very shallow punctures; scutellar furrow very fine, minutely pitted; scutellum mat with scattered shallow punctures; propodeum smooth and shining laterally, weakly punctate medially; mesopleuron mat closely punctate anteriorly, smooth posteriorly and above, the longitudinal impression broad and shallow with some irregular, weak, vertical wrinkles; metapleuron mat smooth, radius barely longer than intercubitus; hind coxa mat, mostly smooth, with an elongate flattened area on outer upper edge at base; inner calcarium of middle tibia slightly longer than metatarsus; inner calcarium of hind tibia about three-fifths as long as metatarsus. Abdomen very slender, compressed; plate of first tergite parallel-sided to apical third, from where it narrows strongly to apex, entirely smooth and polished, its width at apex less than half the length of second tergite; plate of second tergite triangular, bounded laterally by sharp oblique grooves, entirely smooth and polished; hypopygium not attaining apex of abdomen; ovipositor sheath subexserted.

Black; wings hyaline; stigma dark brown, veins paler; all coxae black; trochanters, femora, tibiae, and tarsi of fore and middle legs entirely yellow; posterior femur reddish-yellow, apical third blackish; posterior tibia yellow, blackish on apical two-fifths; posterior tarsus blackish, pale at base.

Male. In all essentials similar to female but with the middle and hind legs darker; hind femur entirely black; hind tibia black on apical half.

Type locality. PASADENA, CALIFORNIA.

Type. United States National Museum No. 58214.

Described from the female type and three male paratypes reared from *Anacamptodes fragilaria* (Grossb.) at the type locality in October 1945, by N. L. H. Krauss; one female from Los Angeles, California, and one from "Southern California," both reared from *A. fragilaria* in January 1946, by Mr. Krauss; and nine males bred by Mr. Krauss in the laboratory at Honolulu, Hawaii, January 1946, upon the same host.

ENOCLERUS HUMERALIS (SCHAEFFER), A PRIMARY HOMONYM

(Coleoptera, Cleridae)

BY WILLIAM F. BARR
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In 1823, Thomas Say, in the Journal of the Academy of Natural Sciences of Philadelphia, volume 3, page 192, described a new species of Cleridae and gave to it the name *Clerus humeralis*. This species was later placed in the genus *Hydnocera* and at the present time, correctly belongs in the genus *Phyllobaenus*. Charles Schaeffer in 1905, apparently not aware of the previous usage of the trivial name *humeralis* in the genus *Clerus*, described a different species of Cleridae under this same name—*Clerus humeralis*, in the Bulletin of the Brooklyn Institute of Arts and Sciences, volume 1, page 155. This species has since been placed in the genus *Enoclerus* by some workers.

According to the International Rules of Zoological Nomenclature, Article 35, "A specific name is to be rejected as a homonym when it has previously been used for some other species or subspecies of the same genus." Both Say's species and Schaeffer's species are now in different genera, but the important fact is that both species when described, were placed in the genus *Clerus*. Thus *Clerus humeralis*, as described by Schaeffer, is a primary homonym and cannot stand. Therefore, *Enoclerus schaefferi* Barr, new name, is proposed by the writer to take the place of *Clerus humeralis* Schaeffer (nec Say).

DESIGNATION AND DISTRIBUTION OF TYPES OF NEPTICULA BRAUNELLA JONES

(Lepidoptera: Nepticulidae)

FREDERICK H. RINDGE
University of California, Berkeley

W. W. Jones, in his paper, "The description and biology of *Nepticula braunella* new species (Lepidoptera: Nepticulidae), a species of leaf miner on *Prunus ilicifolia* Walp. and the variety *integrifolia* Sarg." (1933, Univ. Calif. Publ. Ent., 6(4):49-78), did not designate the types nor give any data on the type series.

The material, upon which this paper and the above-mentioned description were based, had been retained in the Jones collection until recently when it was turned over to Professor E. O. Essig of the Division of Entomology and Parasitology of the University of California. This matter was called to the writer's attention by E. O. Essig, and the following type designations have been made.

Lectoholotype, male, BERKELEY, CALIF., Mar. 22, 1928 (W. W. Jones), No. 5682, California Academy of Sciences, Entomology; *lectoallotype*, female, Berkeley, Calif., April 3, 1928 (W. W. Jones), No. 5683, California Academy of Sciences, Entomology. *Lectoparatypes*, 105 specimens of both sexes, all from Berkeley, Calif. (W. W. Jones), with the following range of dates: April 20-30, 1924; March 1-20, 1925; March 8-14, 1927; March 9-April 15, 1928; April 2-20, 1929.

The lectoparatypes are to be distributed as follows: six each to the American Museum of Natural History, British Museum of Natural History, Canadian National Collection, Los Angeles Museum, Museum of Comparative Zoology, United States National Museum, and collection of writer; the remainder to be deposited in the collections of the University of California, Berkeley, and the California Academy of Sciences.

Attention is drawn to the fact that this species was not included in the "Check List of the Lepidoptera of Canada and the United States of America. Part II. Microlepidoptera" (J. McDunnough, 1939. Mem. So. Calif. Acad. Sci., 2:1-171), and should be added thereto.

TWO NEW SPECIES OF BEES FROM ARIZONA
(Hymenoptera, Apoidea)[1]

BY P. H. TIMBERLAKE[2]
University of California Citrus Experiment Station, Riverside, California

The types of the new species here described are included in the collection at the University of California Citrus Experiment Station, Riverside.

Heriades (Neotrypetes) micheneri Timberlake, new species

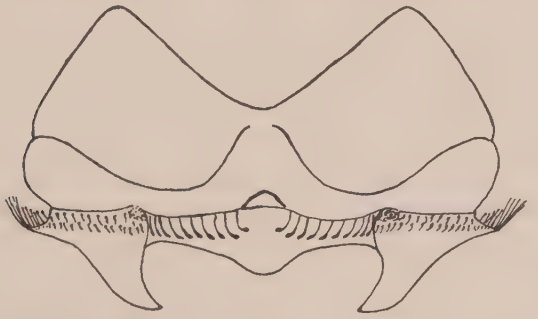
In Michener's table of *Neotrypetes* (Ann. Ent. Soc. Amer., 31:517, 1938), the female runs to *variolosa* (Cresson) and differs in having a broad, very shallow emargination in clypeal margin, armed with five small denticles; punctures of frons coarser than those of mesoscutum; and abdominal bands very narrow and absent on the fifth tergite. The male runs to *leavitti* Crawford in the same table, but differs in having the first ventrite truncate at apex, hardly produced, and armed on its disk with a large conical process that ends very bluntly, as seen both from behind and from the side. The process, therefore, is much like that of *carinata* Cresson, which belongs to a different group.

Female. Black, the apex of last joint of tarsi and claws brownish testaceous. Apex of mandibles, tegulae, and smooth inner surface of legs more or less tinged with dark reddish. Mandibles not broadened at apex, twice as long as wide, the two carinae on outer surface parallel, but uniting close to the apex. Cutting edge of mandible tridentate. Clypeal margin very broadly truncate, with a slight broad median emargination armed with five small denticles. Punctures of frons and vertex very coarse and close, with those of face below antennae and of cheek much smaller. Punctures of mesocutum, scutellum, and mesopleura coarse and close but slightly smaller than those of frons. Punctures of abdomen coarse and close, becoming coarser and shallow on tergite 3, where they are nearly as coarse as those of thorax. Pubescence very fine, short and inconspicuous, except for patches of white plumose hair on sides of face, pronotum, area around tubercles and base of wings, and on apical margin of scutellum and suture between

[1]Paper No. 554, University of California Citrus Experiment Station, Riverside, California.
[2]Associate Entomologist in the Experiment Station.

meso- and metapleuron. Hair of legs short and scanty, except on tarsi; that on inner side of hind tarsi long, abundant, and pale fulvous. Apical hair-band on tergites 1 to 4 white and very narrow, except that the one on first tergite is considerably widened on each side. These bands composed of small scalelike hairs, with microscopic plumosity. Scopa white. Wings uniformly grayish dusky, with dark fuscous nervures and stigma. Length, 5.25 mm.; anterior wing, 3.5 mm.

Male. Similar to female in puncturation and pubescence. Front femora, except behind, and front tibiae reddish ferruginous. Apical joint of front tarsi entirely ferruginous. Anterior side of middle femora dark reddish. Mandibles narrow and bidentate. Clypeal margin simple. Face more narrowed than in female. Punctures of head and thorax a little less coarse and dense. Punctures of first two tergites as in the female; those of the third a little



coarser but not shallow as in the female. Femora strongly swollen (much more so than in *variolosa* and other species). Front tarsi short and broadened, the first joint about twice as long as wide, the three middle joints very short and strongly bilobate about as in *bruneri* Titus. Face between antennae and clypeus covered with white plumose hair. Dense white hair also on anterior part of cheeks, especially the gular region, on the coxae, the apical part of first ventrite, and disk of second ventrite. Front tarsi with a white fringe behind, and hair on inner side of hind tarsi whitish. Apical bands of white scalelike hairs on abdomen present only on tergites 1 to 3, and not widened at sides of first segment. Fifth ventrite (fig. 1) deeply and broadly emarginate at apex, the emargination formed by a large triangular lobe on each side, the tips of lobes acute and curved inward. A small acuminate tooth on outer side of base of these lobes. Base of the emargination armed with a transverse band of rather short, erect, curved hairs, which are strongly capitate at apex, except a few longer hairs at tips of the lateral teeth. Sixth ventrite as in allied species, the triangular apical part having a patch of fine, long hairs on each side. Length, about 5 mm. (or 6.5 mm. with abdo-

men extended to expose the ventral segments); anterior wing, 3.7 mm.

Described from a pair (*holotype* female and *allotype*) taken on damp sand, PATAGONIA, ARIZONA, August 8, 1940 (Timberlake).

Named for Charles D. Michener, who has given us an excellent revision of North American *Heriades*.

Calliopsis squamifera Timberlake, new species

Allied to *andreniformis* Smith and *rhodophila* Cockerell, but differs in the white face markings and very long slender middle tarsi. It is probably closer to the little-known *teucrii* Cockerell, the female of which has white markings, but differs from *squamifera* in larger size, piceous tegulae, and dusky wings.

Male. Black, the mandibles, except reddish tips, labrum, and face below antennae, white. Supraclypeal and lateral marks extending above level of antennae almost exactly as in *andreniformis*. Scape broadly in front, interrupted band on hind border of pronotum, and tubercles, yellowish white. Flagellum, a large quadrate area on middle of mesosternum, and legs lemon-yellow, the tarsi being a little more brownish, and apical joint of hind pair dusky. Flagellum dusky behind, the obscurity more pronounced on basal joints and there extending further around the joints. Scape behind and pedicel black. Narrow apical depression of tergites testaceous brown. Tegulae pale testaceous with a white dot. Wings nearly clear, the neuration pale testaceous brown. Large callus-like areas on metanotum pale grayish-brown (described more in detail below). Form more slender than in *andreniformis*. Head broader than thorax, somewhat broader than long, with the inner orbits of eyes slightly converging below. Clypeus not prominent as in *andreniformis*. Legs slender, nearly as in *rhodophila* and *andreniformis*, except that the middle tarsi are extremely slender and elongate. Recurrent nervures received at nearly equal distances from base and apex of second submarginal cell. Puncturation similar to that of *andreniformis*, but the dark part of frons with relatively coarser, shallow, and subconfluent punctures, mesoscutum a little more sparsely punctured, and mesopleura nearly impunctate. Pubescence white, nearly as in *andreniformis*, except that the hairs of clypeus are less bristle-like. Length, 4 mm.; anterior wing, 2.8 mm.

Holotype, a male, at flowers of *Euphorbia*, PICACHO PASS, ARIZONA, August 7, 1940 (Timberlake). The type was taken with a small series of *Calliopsis* (*Perissander*) *anomoptera* Michener, at the type locality of the latter species.

The males of the typical group of *Calliopsis* (the male of *teucrii* being unknown) may be distinguished by the following key:

1. Face yellow; middle tarsus no more than twice as long as tibia; callus-like areas of scutellum and metanotum black.....2
– Face white; middle tarsus about thrice as long as tibia; callus-like areas of scutellum and metanotum pale grayish-brown..... *squamifera*
2. Legs and scapes yellow; clypeus convexly prominent in middle; callus-like areas of metanotum small and widely separated ..... *andreniformis*
– Scape black, or at most with a slender yellow line in front; femora black, except at apex, and tibiae with a black patch behind; callus-like areas of metanotum very large and contiguous; clypeus less prominent..... *rhodophila*

The callus-like areas of scutellum and metanotum of the male in the typical group of *Calliopsis* are reported here for the first time, I believe. These areas in *rhodophila* and *andreniformis* are opaque black and densely covered with extremely short, moss-like pubescence. In the latter species the areas are comparatively small, those on scutellum being easily hidden by the wings, as they occupy the depression between the disk of scutellum and base of hind wings. Posterior border of areas on scutellum yellowish white, with a little patch of whitish hair. Areas on metanotum cover all but the median fifth of the segment, the middle part being subpulvinate and provided with long, erect hairs.

In *rhodophila* the areas on scutellum are large, so that the exposed disk covers rather less than one-third of the total width of segment, and as seen from in front or behind its surface is slightly below that of the somewhat protuberant lateral areas. The latter are pale testaceous or whitish on the hind border as in *andreniformis*. The areas on metanotum are extremely large in *rhodophila*, and subquadrate, extending about two-thirds of the distance from base of metanotum to apex of propodeum. They appear to extend far over the base of the propodeum, and are contiguous except on the basal half, where there is a very narrow line of the normal metanotum exposed and provided with a tuft of long hair.

In *squamifera* the peculiar areas are pallid and covered with fine, shingled, or overlapping scales. The areas on the scutellum are small and restricted to the lateral impressed part of the scutellar sclerite, as in *andreniformis*. On the metanotum they are

large and broadly oval, not quite meeting medially, with the constricted hairy area at base in the form of an equilateral triangle. They reach a little more than half way from base of metanotum to apex of propodeum.

I have seen similar structures, but apparently glabrous, and hence more callus-like, on the scutellum and metanotum of the male of a small undescribed species of *Nomadopsis* from Texas.

SOME RECORDS OF PARASITISM OF SOLITARY BEES BY CONOPID FLIES

BY J. W. MacSWAIN AND G. E. BOHART
University of California, Berkeley

Conopid flies have been observed in the field to attempt oviposition in many species of bees including *Apis mellifica* L. In addition, the considerable variation in size among the individuals of a single species may also indicate a lack of host specificity.[1] However, many records of successful parasitism will have to be collected before a clear picture of the degree of host specificity can be obtained. For this reason the following observations are placed on record.

Three dead adults of *Andrena vierecki* Ckll., each with a conopid puparium in its abdomen, were taken from burrows in a small nesting site of this bee at Berkeley, California, on March 14, 1939. During the following spring, adults of *Myopa rubida* Bigot emerged from two of the specimens. The same conopid species was observed striking *Diandrena chalybioides* Viereck and *Andrena complexa* Viereck on flowers of buttercup, *Ranunculus californicus* Bentham, one mile west of Orinda Crossroads, Contra Costa County, California, on April 11, 1946. When a series of these two species of bees were taken into the laboratory and dissected, two out of eight of the *Diandrena chalybioides* had a small dipterous larva attached to the outer wall of the foregut, although twenty-five *Andrena complexa* contained neither eggs nor larvae of the parasites.

One dead female of *Panurginus melanocephalus* Ckll., containing a conopid puparium was taken from a burrow at Berkeley on March 16, 1939. Although the fly did not emerge from the bee, upon dissection it was recognizable as a member of the genus *Zodion*.

[1]Bohart, G. E., 1941. The oviposition of conopid flies upon smaller andrenid bees. Pan-Pac. Ent., 17(2):95-96.

NEW SPECIES OF THE GENUS TRIOZOIDA
(Psyllidae, Homoptera)[1]

BY LEONARD D. TUTHILL
University of Idaho, Moscow, Idaho

The three species of *Triozoida* herein described bring to four the total number assigned to this genus. Although quite distinct from one another they form a very homogeneous group which is readily distinguished from the other genera of Triozinae. The principal distinguishing characters are the presence of more than one spine on the lateral surface of the apex of the metatibia, the shape of the vertex and genal processes. While the wing venation is similar, it shows considerable variation between species.

Two of the species included have been received from Senor S. C. Bruner of the Estacion Experimental Agronomica, Santiago de las Vegas, Cuba. The third, from Panama, is in material borrowed from the United States National Museum.

Triozoida media Tuthill, new species

Length to tip of folded wings, 3-3.5 mm.

Color: General color green to chocolate brown. More teneral specimens green with legs, tip of antennae, vertex and thoracic dorsum brownish. Fully matured males dark brown except basal portion of antennae, meso-scutellum, thoracic venter, genitalia green to yellow. Wings hyaline except area about furcation of M, Cu and R and spot on margin of clavus embrowned.

Structure: Head narrower than thorax. Vertex minutely pubescent, concave, smoothly rounded down to genae, medial suture prominent. Lateral ocelli raised. Genae produced as blunt, widely separated lobes, contiguous basally. Clypeus visible as third medial lobe. Antennae arising far down on genae, slender, twice as long as width of head. Eyes of moderate size, hemispherical. Thorax well arched. Pronotum large, nearly vertical, not depressed below vertex. Mesopleurites strongly developed. Forewings straight, acutely angled, 2.8 times as long as wide; basal vein short, Rs short, nearly straight to costa, not reaching furcation of media, medial cell much larger than cubital, latter strongly flattened. Head wings 0.6 as long as forewings. Metatibiae without basal

[1]Published with the approval of the Idaho Agricultural Experiment Station as Research Paper No. 263.

armature, 2 outer and 3 inner apical spines. Metacoxae raised anteriorly.

Male proctiger produced caudad basally, tapered to narrow apex. Forceps as long as proctiger, in lateral view parallel-sided, somewhat curved caudad, tapering apically; in caudal view stout, arched to black tips; in dorsal view apices concavely narrowed to small, truncate, black tooth. Female genital segment 0.75 as long as rest of abdomen, stout; dorsal valve with small, blunt styliform apex; ventral valve slender, equalling dorsal, acute.

Holotype, male, *allotype*, female, 1 male and 4 female paratypes, all collected by J. Acuna in the SIERRA DE ANAFE, HAVANA PROVINCE, CUBA, February 24, 1946. They were found in the tender leaves of *Eugenia rocana* Britton and Wilson enclosed by the leaves which were folded lengthwise and somewhat misshapened, forming a kind of pseudo gall.

Holotype, allotype and paratypes in author's collection, paratypes in collection of the Estacion Experimental Agronomica, Santiago de las Vegas, Cuba.

This handsome species resembles *T. johnsonii* but is readily distinguished by the shorter radial sector and smaller cubital cell of the forewing and the less bulging vertex.

Triozoida mutabilis Tuthill, new species

Length to tip of folded wings, 3-3.4 mm.

Color: General color rufous with legs, tip of antennae, vertex and genal processes brown to black or general color greenish yellow with rufous areas on sclerites of thorax and abdomen, legs and antennae darker, genal processes black. Wings hyaline, without dark areas.

Structure: Head narrower than thorax, strongly deflexed. Vertex excavate between eyes, strongly depressed discally, bulging far over median ocellus, medial suture prominent. Lateral ocelli strongly raised. Genae produced as widely separated, blunt cones, concave on meso-cephalic surface, not touching basally. Clypeus small, visible between genal processes. Antennae slender, 1.6 times as long as width of head, arising far down on genae. Eyes large, hemispherical. Thorax broad, rather flat. Pronotum small, vertical, below caudal margin of vertex. Mesopleurites well developed. Forewings broad, obtuse apically, 2.7 times as long as wide; basal vein short, Rs long and somewhat sinuate, equalling or exceeding M_2, medial cell larger than cubital, latter somewhat flattened. Hind wings 0.6 as long as forewings. Metatibiae with serrate basal carina, 2 outer and 3 inner apical spines. Metacoxae raised anteriorly.

Female genital segment 0.66 as long as rest of abdomen, stout; dorsal valve blunt, slightly attenuate at apex; ventral valve slender, acute, nearly equalling dorsal.

Holotype, female, Moa, Oriente Province, Cuba, April 13, 1945, one female *paratype* same locality, November 15, 1945. Both specimens were collected by J. Acuna.

The two specimens at hand show marked difference in size and coloration. The specimen which was collected in November is smaller and of a nearly uniform rufous color. The differences are similar to those encountered in specimens of the same species collected in moist and arid regions elsewhere. While unfamiliar with the climate of northeastern Cuba, I would conclude that the November specimen developed during a hot, dry period.

This species resembles *T. johnsonii* but is readily distinguished by the smaller size, broader and obtusely pointed wing and shorter antennae.

Triozoida inconstans Tuthill, new species

Length to tip of folded wings, 2.5 mm.

Color: Head dark brown, shining. Antennae light basally, darkening toward tip. Thorax chocolate brown dorsad, lighter ventrad. Legs lighter, metatibiae almost white. Forewings dark brown along basal vein and radius to costa. Abdomen brown dorsad, nearly white ventrad. Female lighter, thorax yellowish.

Structure: Head small, narrower than thorax. Vertex smoothly excavate between eyes, protruding anteriorly over median ocellus, smoothly rounded to genae. Genae produced as short, blunt, widely separated processes. Clypeus showing between genal processes as a third similar lobe. Antennae about twice as long as width of head. Eyes small, hemispherical. Thorax broad, rather flat. Pronotum strongly depressed but not below center of vertex. Mesoscutum finely punctate. Forewings slender, 3 times as long as wide, acutely angular; basal vein strongly raised, branching variable, M and Cu often with distinct common petiole, Rs short, nearly straight, reaching to or beyond furcation of media, medial cell larger than cubital, latter somewhat flattened. Hind wings 0.6 as long as forewings, minutely setate. Metatibiae with several small teeth basally, outer apical spines varying in size and number, usually 2, some specimens with 3 or 1, in addition several small setae along margin, 3 or 2 inner spines. Metacoxae not raised anteriorly.

Male proctiger produced caudad as blunt triangular lobe, with prominent apical epiphysis. Forceps slightly shorter than proctiger; in lateral view straight, narrow, tapered to sharp black tips; in caudal view slender, strongly arched to apex, small black

tooth at tip. Female genital segment 0.6 as long as rest of abdomen, straight; dorsal valve blunt; ventral valve nearly as long as dorsal, sharp apically.

The number and size of the spines or setae on the apex of the metatibiae is quite variable in this species. In several of the specimens at hand there is a variation between the right and left tibia.

Described from 5 males and 1 female collected at ANCON, CANAL ZONE, PANAMA, June 26, 1919, by H. Dietz and I. Molino, "on Guara."

Holotype, male, No. 56964, United States National Museum, *allotype*, female, and *paratypes* in United States National Museum, paratypes in author's collection.

This handsome species resembles *T. johnsonii* but may be distinguished by its smaller size, coloration and wing venation, especially the shorter, straight radial sector.

AN ADDITIONAL LOCALITY FOR AULICUS TERRESTRIS LINSLEY

(Coleoptera, Cleridae)

BY G. S. MANSFIELD AND J. W. TILDEN

On May 26, 1940, a single specimen of *Aulicus terrestris* Linsley was collected by the writers near Silver Creek Hills, Santa Clara County, California, about twelve miles southeast of San Jose. The insect was found resting on grass in a small meadow in the foothills of Mt. Hamilton.

Although no specimens of the Lubber Grasshopper, *Esselenia vanduzeei* Hebard, were taken at this time, a single specimen was collected in the same area on April 13, 1941. The association of these two insects has been shown by Linsley[1].

This record is only eight or ten miles southwest of a previous one from Mt. Hamilton, but is of interest because of the much lower elevation. The point at which this collection was made is between 1000 and 1500 feet high, whereas the elevation of Mt. Hamilton is about 4200 feet.

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[1]Linsley, E. G., 1936. Studies in the Genus *Aulicus* Spinola. Univ. Calif. Publ. Ent., 6(9):249-262.

A SMALL SAGE APHID

BY GEORGE F. KNOWLTON
Utah State Agricultural College, Logan

The following report deals with an apparently undescribed genus and species of sagebrush aphid. Distribution records for a few species in the genus *Microsiphum* are also included.

Zyxaphis Knowlton, new genus

Size small; head with antennal tubercles undeveloped; antennae six segmented (sometimes with tendency for antennals III and IV to not fully separate); sensoria of antennae circular to subcircular, not abundant; fore wings with the media twice branched; hind wings with both media and cubitus present; cornicles truncate, sub-cylindrical, not longer than thick; cauda slightly developed, with numerous hairs and with some tendency to be angular at apex; anal plate rounded; lateral tubercles on abdomen prominent; reticulated areas on cuticula of abdomen.

Type, *Zyxaphis utahensis* Knowlton.

Zyxaphis utahensis Knowlton, new species

Alate vivipara: Size small, body 1.52 to 1.6 mm. long and .72 to .8 wide across abdomen; ocular tubercles well developed; antennal tubercles undeveloped; antennae .64, dusky to blackish and imbricated beyond antennal II; antennal III and IV with a tendency not to fully divide (on 2 of the antennae); antennal III, .16 mm long with 2 to 4 sensoria; IV, .112 to .15 with 0 to 1 sensorium; V, .128 to .132; VI, .093 plus .078, to .096 plus .08; restrum reaching second coxae, tip acute, rostral IV + V, .14 mm. long; wing venation normal, media twice branched; hind tibiae pale to dusky near apex, .51 to .61 mm. long; hind tarsi .07 to .115; lateral portions of body cuticle reticulated in some areas; lateral tubercles prominent; cornicles .033, dusky, truncate, about as broad as long, short-cylindrical in shape, imbricated; cauda short, dusky, broadly triangular with blunt apex; abdominal tubercles well developed.

Collection: Taken on *Artemisia tridentata* at Mt. Carmel, Utah, May 24, 1940, by G. F. Knowlton. Type in the collection of the writer.

Taxonomy: Zyxaphis utahensis differs conspicuously from *Microsiphum acophorum* S.-K. and other *Microsiphum* species occurring in Utah in having the unguis of antennal VI shorter than base; cauda somewhat larger and with tendency to be angular rather than rounded as in *Cryptosiphum artemisiae* Buckton, and with prominent lateral tubercles.

Microsiphum acophorum S.-K. collected on *Artemisia tridentata* at Lakota, Bear Lake, Utah, July 29, 1945; Battle Mt., Nevada, August 16, 1945; Elko, Nevada, July 1, 1939; Wells, Nevada, August 20, 1943; Thousand Springs, Idaho, August 8, 1939.

M. artemisiae (Gillette) on *Artemisia vulgaris* and *A. tridentata* at Oak Creek Canyon, Utah, July 10, and Junction, Utah, July 11, 1942; Snowwater Lake, Nevada, August 20, 1943; Wells, Nevada, August 16, 1945; Craig, Montana, August 5, 1944; Tumalo, Oregon, August 24, 1944 (Knowlton); also Blue Gulch and Castleford, Idaho, September, 1932 (D. E. Fox).

M. oregonensis Wilson on *Artemisia*, Cornish, Utah, July 15, 1941.

NOTES ON SOME COLEOPTERA TAKEN FROM WET PAINT

On April 18 of this year I collected nearly 250 beetles from a newly painted bridge at Ben Lomond, California, in the Santa Cruz Mountains. Although the paint was nearly dry, many of the insects were still alive. Among the thirty-five species collected was the rather rare clerid, *Thanasimus repandus* Horn, represented by twelve individuals; probably the greatest number to be collected at one time. Four specimens were taken of another noteworthy clerid, *Thanasimus undatulus rubiventris* Lec. Of the twelve families represented, the Scolytidae had the largest number of species (six) and individuals. Many other insects were also trapped in the paint but were not collected. Ordinary paint remover proved satisfactory in cleaning the specimens.

The attractiveness of paint to beetles was also cited by Essig in Vol. XIX, p. 91, of this journal in some notes on *Rosalia funebris* Mots.—E. S. DETHLEFSEN.

ON FOUR NEW AMERICAN CHILOPODS

BY RALPH V. CHAMBERLIN
University of Utah, Salt Lake City

The new species here described were noted while identifying several small collections submitted to me by Dr. A. M. Woodbury, from Utah, P. W. Fattig, from Georgia, and Dr. J. M. Linsdale from California. The types are retained at present in the author's collection.

SCHENDYLIDAE

The new species described below is the first of the genus to become known from the western United States. It is essentially a northern genus, being represented by two species from the northeastern states and by five in Alaska and northeastern Asia. Its extension down the western mountains into the United States is natural. The known species of the genus may be separated by means of the following key.

KEY TO SPECIES OF ESCARYUS

1. Claw of anal legs as large as those of the penult pair.....2
– Claw of anal legs small in comparison with those of other legs..4
2. Last sternite as broad as long narrowed caudad; Anal coxae with only 5 or 6 pores (Alaska).....*E. albus* Cook
– Last sternite narrow, relatively long, scarcely narrowed; coxal pores more numerous (Northeastern United States).....3
3. Yellowish brown in color; 41 pairs of legs..*E. urbicus* (Meinert)
– Waxy white; 49 pairs of legs.....*E. liber* Cook
4. Anal pores present.....5
– Anal pores absent.....6
5. Pairs of legs 47; last ventral plate narrow, with sides nearly parallel (Alaska).....*E. delus* Chamberlin
– Pairs of legs 43; last ventral plate broad, conspicuously narrowed caudad (Utah).....*E. monticolens* Chamberlin, n. sp.
6. Pairs of legs 33 (Alaska).....*E. paucipes* Chamberlin
– Pairs of legs 49-51.....7
7. Syncoxite of first maxillae with long membranous lappets; lateral teeth of labrum with long slender tips.....*E. sibiricus* Cook
– Syncoxite of first maxillae without lappets; all teeth of labrum short and stout.....*E. japonicus* Attems

Escaryus monticolens Chamberlin, new species

Apparently related to the Alaskan *E. albus* Cook. It differs in general appearance in being yellow, with head and prehensors

darker, instead of being a waxy, translucent white. It differs in the more numerous soxal pores these numbering about 18 on each side instead of 5-6. Last ventral plate trapeziform, about equal in length to the anterior width. Claws of the anal legs somewhat smaller than those of the penult legs.

Cephalic plate broadest anteriorly, considerably overlapping the basal plate the exposed portion of which is short. Clypeus wholly lacking nonerelate fields. Labrum evenly and moderately incurved, the teeth all stout and subconical, 15 in number. First maxillae with palpi having well developed lappets. Coxosternum of second maxillae with anterior border deeply notched at the middle, the median area less sclerotized, membranous. Mandible with teeth in three blocks; e.g., 3, 3, 4.

Anal pores present.

Number of pairs of legs, 43.

Length, 18 mm.

Locality. UTAH: MILL CREEK CANYON. One female dug up in soil at an elevation of about 7,500 ft. A. M. Woodbury, collector.

LITHOBIIDAE

Nadabius cherokeenus Chamberlin, new species

Dorsum brown or light chestnut. Legs proximally pale, but with the fourth and fifth joints brown and the tarsus yellow. Antennae brown.

The antennae composed of the usual 20 articles which are of moderate length. Ocelli in 4 longitudinal series; thus, 1+5, 5, 4, 3.

Prosternal teeth 2 2; the median incision acute.

None of the dorsal plates produced.

Coxal pores, small and circular; 2, 3, 3, 3.

Ventral spines of first legs, 0, 0, 1, 2, 1 (2); dorsal, 0, 0, 0, 1, 1. Ventral spines of penult legs, 0, 1, 3, 2, 1; dorsal, 1, 0, 2, 1, 0; claws 2. Ventral spines of anal legs, 0, 1, 3, 1, 0; dorsal, 1, 0, 2, 0, 0; claw single. Last two pairs of coxae laterally armed.

The anal legs of the male with the usual subdorsal crest at distal end of the fifth joint, its form and relations as shown in the accompanying figure. Length, 10 mm.

Locality. GEORGIA: ATLANTA. A male taken February 17, 1946, by P. W. Fattig.

Distinguished from all other known species excepting *N. eremites* in having the dorsal spines of the anal legs 1, 0, 2, 0, 0 and those of the penult 1, 0, 2, 1, 0.

It is separated from *N. eremites* chiefly on the basis of having the last two pairs of coxae laterally armed, whereas they are unarmed in *eremites*, and of having the ocelli in 4 series instead of in 3.

Arebius sequens Chamberlin, new species

A species agreeing with *A. crenius* and differing from *A. dolius*, to which it runs in the key, in having the claw of the female genital forceps distinctly tripartite, the lateral lobes smaller than the median which, however, is short and relatively broad. The basal spines of the genital forceps slender, subcylindrical but narrowest at middle, the acuminate apex short. It differs from *crenius* in having the dorsal spines of the 12th and 13th legs 1, 0, 3, 1, 1 instead of 1, 0, 3, 2, 2. It also differs in the more numerous ocelli arranged in three series instead of in two; e.g., 1 5, 4, 3.

Length, 10 mm.

Locality. CALIFORNIA: MONTEREY COUNTY, HASTINGS RESERVATION. A male and female taken June 10, 1943, by Dr. J. M. Linsdale.

Nadabius cherokeenus Chamberlin, n. sp. Fifth segment of left anal leg, subdorsal view.

Arebius petrovius Chamberlin, new species

In the author's key this form runs out to *A. diplonyx* of the Santa Barbara region. It is like that species in having two claws on the anal leg, but the supplementary claw is very small instead of being rather large and distinct. It is also like that species in having the claw of the female genital forceps tripartite; the basal spines, however, are acuminate from base instead of being cylindrical to an acuminate apical part.

The ventral spines of the penult legs are 0, 1, 3, 3, 1 instead of 0, 1, 3, 3, 2, the dorsal being 1, 0, 3, 1, 1. Dorsal spines of anal legs 1, 0, 3, 1, 0, the ventral 0, 1, 3, 3, 0. Last two pairs of coxae laterally armed.

The ocelli are fewer and are in two series instead of in three; e. g., 1+3, 2 or 3, 3.

Length, 7-7.5 mm., thus being smaller than *A. diplonyx* which is 8 to 8.5 mm. long.

Locality. CALIFORNIA: MONTEREY COUNTY, FINCH CREEK.

Four specimens under a rock, taken March 24, 1945, by Dr. J. M. Linsdale.

NOTES ON HIPPOMELAS CALIFORNICUS (HORN) AND CHRYSOBOTHRIS CYANELLA HORN
(Coleoptera: Buprestidae)

BY GEORGE S. MANSFIELD
Atascadero, California

Hippomelas (*Nanularia*) *californicus* (Horn) and *Chrysobothris cyanella* Horn have been taken by the author at Atascadero, San Luis Obispo County, California, on a wild buckwheat, *Eriogonum nudum* Dougl. These records represent a new locality and considerably extend the range of both species. Further, some additional notes on each species are presented.

Hippomelas (Nanularia) californicus Horn

Two specimens of this species were taken on the stem of wild buckwheat on June 23, 1940, and thirteen additional specimens were collected during July, 1946, at Atascadero. These specimens average 9.5 mm. in length and range from 7.0 mm. to 10.8 mm. Although the color of this species is a deep reddish brown, individuals in the field appear quite gray due to their coating of white pile. Most of the specimens were taken within six inches of the ground on the buckwheat stem. Several of those taken late in July, 1946, were collected higher up, where they were observed feeding on the outer layers of the stem.

This beetle is very rare in collections. Van Dyke (1942) mentions three specimens in the collection of the California Academy of Sciences. Subsequently the Academy has added another specimen collected August 21, 1927, at Laguna, San Diego County, California, from the collection of W. J. Chamberlin. Through the kindness of Prof. N. Banks, I have had an opportunity to examine two additional specimens in the LeConte Collection at the Museum of Comparative Zoology, Harvard University. These are from "California" and were collected by Horn. One is labeled "Type", although Van Dyke (1942) states that the species was described from a unique collected by Horn and now in the Philadelphia Academy of Sciences.

Judging from the distribution of the collected specimens (Calaveras, Santa Cruz, San Luis Obispo, and San Diego coun-

ties), it appears probable that this species is to be found throughout cismontane California, ranging from elevations of 4000 feet (Laguna, San Diego Co.) to 1000 feet, or lower. Because of its habit of moving to the opposite side of the stem from the collector and its rather inconspicuous color and pattern, this species is probably often over-looked. This buprestid was taken in 1940 and 1946 in the same restricted stand of *Eriogonum nudum* and observations of other stands of this plant in surrounding areas failed to produce more specimens.

Chrysobothris cyanella Horn

Thirteen specimens of this species were collected on the stems of *Eriogonum nudum* at Atascadero during the period from May 28 to July 15, 1946. Other collectors have taken this species in Oregon and California from the flowers of wild buckwheat. All of the author's collections were made from the stems of the buckwheat, where the beetles were resting, and most of them were taken before the plants came into bloom in July. The average length of these specimens is 7.2 mm. and they range from 5.8 mm. to 8.3 mm. The color ranges from a bright bluish green to a violaceous blue. The individuals collected in July were mostly blue, whereas those taken in May and June were all bluish green.

Fisher (1942) states the distribution of this species to be from Ashland, Oregon, south to Kings River and Bishop, California, and mentions one record of Chamberlin's from Pasadena. The specimens in the California Academy of Sciences collection range from Modoc and Humbolt counties to Kings River and Bishop, and Tonopah, Nevada. The specimens from Atascadero appear to be the first record of this species from the Coast Range of California and from such a low elevation (1000 feet), with the exception of the Pasadena record (which may have been collected on a mountain near there.) Most of the specimens in the Academy collection are from the Sierra Nevada Mountains at elevations in excess of 5000 feet.

This species was taken on the same restricted stand of *E. nudum* at Atascadero as the preceding species. Likewise, no other collections were made in surrounding areas, although a periodic search was made for them.

I am indebted to Dr. E. C. Van Dyke for the identification of

these two species of insects, and to Mrs. Roxana Ferris and Mr. J. W. Tilden of Stanford University for determining the species of buckwheat.

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AN OCCURRENCE OF THE PUPA OF GLAUCOPSYCHE LYGDAMUS BEHRII (EDWARDS) IN AN ANT NEST

(Lepidoptera, Lycaenidae)

BY J. W. TILDEN
Redwood City, California

February 14, 1942, a lycaenid pupa was taken from an ant nest in Alum Rock Park, Santa Clara County, California. The ant nest, in a log of *Quercus agrifolia* Nee, was partly under loosened bark and partly in decayed wood. The lycaenid pupa was surrounded by ant pupae and so situated as to preclude the probability that its presence in the nest was accidental. A normal male of *G. lygdamus behrii* (Edw.) emerged from this pupa on February 21, 1942.

F. X. Williams (1908) gives the food plant of *behrii* as *Lupinus micranthus* Dougl., and obtained a pupa which emerged when reared on this plant under laboratory conditions. Bowler (1911) in recording the early stages of the typical form of *lygdamus*, mentions that the larvae are attended by ants and that cannibalism is common among the larvae. Many lycaenid larvae have been shown to be attended by ants, the ants obtaining secretions from special organs on the lycaenid larvae.

Balduf (1939) gives a full discussion and citation of literature concerning mymecophilous Lycaenidae. European workers have found that the fourth and fifth stadia as well as the pupal stage of certain species are passed in ant nests. The lycaenid larvae are taken into the nests by the ants at the beginning of

the fourth stadium. They then cease phytophagous habits and subsist during the last two stadia upon the pupae of their hosts. The ants in return obtain the secretions of the lycaenids.

A survey of American literature indicates that this habit has not been observed in American species. But the pupa mentioned above either must have been transported to the ant nest as a larva, or allowed to enter it unmolested. This suggests a phase of myrmecophily in American Lycaenidae that so far is not fully understood.

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NORTHWARD RANGE EXTENSION OF OEME GRACILIS LEC.

(Coleoptera: Cerambycidae)

A specimen of *Oeme gracilis* Lec. was found dead beneath a light on the Hale Ranch, about eight miles south of Atascadero, San Luis Obispo County, California, on September 11, 1940. This beetle is apparently rare in collections. There are ten specimens in the collection of the California Academy of Sciences from Los Angeles, Pasadena, and Poway, San Diego County, California. In the Museum of Comparative Zoology at Harvard, there is LeConte's type from Poway, and a specimen from Catalina and two specimens from Ventura(?), in the Fall collection. From these records it appears that the specimen from Atascadero represents a new northern limit of this species.—George S. Mansfield, Atascadero, California.

ANOPHELES XELAJUENSIS DeLEON, A NEW ADDITION TO THE KNOWN ANOPHELINE FAUNA OF PANAMA

BY PEDRO GALINDO
Campaña Anti-Malárica, Ministerio de Previsión Social
Panama, R. de P.

Anopheles xelajuensis DeLeon, was described in 1938 from the high mountains of Guatemala. Vargas in 1942 reported the species from southern Mexico and created the subgenus *Russellia* with this species as the genotype. No other record of it appears in the literature to the writer's knowledge.

During May, 1946, while collecting in the Chiriqui Volcano region, republic of Panama, Dr. G. B. Fairchild, of the Gorgas Memorial Laboratory, and the writer were fortunate in collecting six males and four females of an anopheline identified by the writer as *Anopheles xelajuensis* DeLeon. The specimens were taken while resting in hollow trees in the forest bordering Mr. Louis Martinez' farm, "Carinthia," at an elevation of approximately 6,200 feet.

All the females collected agree rather closely with DeLeon's description of *xelajuensis*, except for the fact that the panamanian specimens have the tip of the wing somewhat darker than the guatemalan female figured by DeLeon. The terminalia of the males from Panama appear to agree in every respect with the published figures of the terminalia of *xelajuensis*.

Mr. W. H. W. Komp, U. S. Public Health Service, who confirmed the writer's identification of this material, informs him that Dr. T. H. G. Aitken collected larvae of *xelajuensis* some years ago in the same general area, but did not rear them through to the adult stage.

The finding of *A. xelajuensis* in Panama increases considerably the known distribution of this species. Further intensive collections in the highlands of Costa Rica and Nicaragua should reveal its presence there, as it appears to have the same general distribution of *Anopheles parapunctipennis*, another highland species known from Mexico, Guatemala, Costa Rica and Panama.

The material on which this report is based has been deposited in the following collections: U. S. National Museum, Washington, D. C.; George Williams Hooper Foundation for Medical Research, San Francisco, Calif.; Campaña Anti-Malárica, Panama, R. de P.; Mr. W. H. W. Komp's.

PACIFIC COAST ENTOMOLOGICAL SOCIETY

E. G. LINSLEY
Vice-President

C. D. DUNCAN
President

E. S. ROSS
Secretary

PROCEEDINGS

One Hundred and Eighty-ninth Meeting

The one hundred and eighty-ninth meeting of the Pacific Coast Entomological Society was held at 2:30 P.M. on April 27, 1946, in the entomological laboratories of the California Academy of Sciences, San Francisco, President Duncan in the chair. The following members were present: R. W. L. Potts, E. G. Linsley, K. E. Frick, C. A. Fleschner, D. J. Raski, H. F. Madsen, J. W. Tilden, E. S. Dethlefsen, P. Moorhead, E. L. Kessel, B. B. Kessel, W. W. Middlekauf, M. A. Stewart, E. C. Van Dyke, R. F. Smith, L. R. Gillogly, G. F. Ferris, G. D. Grant, J. L. Gustafson, C. D. Duncan, A. E. Michelbacher, E. O. Essig, and E. S. Ross. Visitors were present as follows: H. T. Reynolds, C. R. Madsen, H. I. Tilden, D. Giuliani, R. Harlick, W. L. Lee, E. F. Quinnell, L. M. Henry, A. G. Applegarth, R. H. Swan, F. R. Marsh, S. Kennedy, W. H. Hart, L. W. Swan, and B. D. Culver.

The minutes of the previous meeting were read and approved.

The membership committee proposed the following for membership in the Society: Paul D. Hurd, Jr., Lorin R. Gillogly, B. Dwight Culver, Ellsworth Hagen, Welton L. Lee, Winifred H. Hart, Harold T. Reynolds and Karl S. Snyder. They were unanimously elected.

In response to President Duncan's request for notes, observations, and exhibits of entomological interest, Dr. Michelbacher called attention to his observation of an unusually large population of pea weevils in a field of alfalfa and the almost complete absence of eggs in spite of the great density of adults. Dr. Duncan exhibited some well prepared life history specimen mounts for classroom use, recently obtained from Germany.

The President then introduced E. S. Ross who spoke on some of his entomological experiences in Texas, New Guinea, and the Philippines while serving in the Army. During his assignment in Texas as Entomologist for the Eighth Service Command Laboratory at San Antonio, he had many opportunities for general insect collecting on off-duty time. Noteworthy was a special investigation of the arthopod fauna of *Geomys* burrows and nests made during the winter of 1942. Specimens were obtained by direct excavation to the nests and by use of molasses bait traps placed in the sub-

surface runways. The many new and interesting species found, as well as the interesting ecological data, indicate that similar investigations of the burrows of other animals, especially desert rodents, should be made wherever possible.

The speaker then told of his association with Dr. H. R. Roberts of the Philadelphia Academy and their development of the "Mosquito Atlas" which lead to an assignment at the U.S. National Museum where they completed parts dealing with the important malaria vectors of the world. The advantages of the loose-leaf "Atlas" type of publication with standardized treatment and illustrations was emphasized and it was urged that such technique be applied more widely especially in economically important groups of insects.

Later assignments, as Commanding Officer of the 38th Malaria Survey Unit at New Orleans; Finschhafen and Maffin Bay, New Guinea; and on Leyte and Mindoro Islands of the Philippines, provided ample opportunities for mosquito and general insect collecting. Representation lots of specimens, as well as photographs and drawings, were passed among the members and visitors to illustrate the presentation.

Following a brief discussion, the meeting was adjourned.—E. S. Ross, Secretary.

One Hundred and Ninetieth Meeting

The one hundred and ninetieth meeting of the Pacific Coast Entomological Society was held at 2:30 P.M. on October 5, 1946, in the entomological laboratories of the California Academy of Sciences, San Francisco, President Duncan in the chair. The following members were present: E. C. Van Dyke, G. F. Ferris, D. D. Jensen, R. A. Flock, A. E. Michelbacher, E. A. Smith, A. C. Smith, F. J. Driver, J. W. Tilden, R. L. Usinger, E. G. Linsley, E. O. Essig, H. P. Chandler, E. S. Dethlefsen, W. W. Sampson, L. R. Gillogly, W. C. Reeves, B. Brookman, O. B. Cope, L. W. Saylor, E. L. Kessel, F. E. Skinner, B. Dwight Culver, Karl D. Snyder, R. C. Miller, P. D. Hurd, Jr., J. J. DuBois, K. S. Hagen, W. F. Barr, E. A. Steinhaus, and E. S. Ross. Visitors were present as follows: A. G. Applegarth, J. P. Harville, H. I. Tilden, L. M. Henry, E. C. Winkler, J. R. Fisher, A. H. Storm, I. L. Eads, Clark O. Eads, A. W. Larson, H. K. Townes, Raymond Thomas, J. E. Lydon, F. B. Marsh, Mrs. K. D. Snyder, M. A. Qaiyum, M. Basheer, T. O. Thatcher, U. N. Lanham, E. G. Meyers, K. E. Hughes, B. Prendergast, H. H. Pehrson, L. Dunn, and E. F. Quinnell.

The minutes of the previous meeting were read and approved.

The membership committee proposed the following for regular membership in the Society: Edwin Quinnell, Miss La June Dunn, Clark O. Eads, and John Harville. Frank Skinner was proposed for student membership. They were unanimously elected.

President Duncan then appointed a Nominating Committee comprising Dr. Middlekauf (Chairman), Dr. Kessel, and Dr. Usinger to nominate candidates for the election of officers at the Annual Meeting.

Dr. E. C. Van Dyke was called upon to speak on the life and work of the late Dr. F. E. Blaisdell, a Charter Member of the Society. He was followed by Dr. E. S. Ross who spoke on the life and work of the late Mr. F. E. Nunenmacher, also a Charter Member. Biographies on these members will be published in forthcoming issues of the Pan-Pacific Entomologist.

Dr. H. K. Townes, Division of Insect Identification, U.S.D.A., reported briefly on his recent insect survey of the formerly Japanese mandate islands. His remarks were illustrated by a series of photographs of insect damage and scenery.

Dr. D. D. Jensen, recently returned from Hawaii, mentioned the trend toward diversity in Hawaiian agriculture and the resultant increase in entomological problems.

J. W. Tilden exhibited a collection of microlepidoptera reared from the plants growing on the Stanford University campus. He also reported on sugar beet leafhoppers migrating to tomatoes which showed little resultant virus damage. Dr. Michelbacher stated that this was probably due to the late infection but that a loss in fruit size could probably be measured.

Following these notes and observations, President Duncan then called on Dr. R. L. Usinger who presented the main paper of the program entitled "The systematics and biology of the Triatominae." His presentation was illustrated by drawings, charts, and boxes of specimens. His remarks were largely based upon his recent paper on this subject which appeared in Public Health Bulletin No. 288, 1944.

Following a lively discussion on Dr. Usinger's paper, the meeting was adjourned.—E. S. Ross, Secretary.

One Hundred and Ninety-first Meeting

The one hundred and ninety-first meeting of the Pacific Coast Entomological Society was held at 2:30 P.M. on January 4, 1947, in the entomological laboratories of the California Academy of Sciences, San Francisco, President Duncan in the chair. The following members were present: W. W. Middlekauff, E. C. Van Dyke, R. L. Usinger, H. F. Madsen, W. H. Hart, K. E. Frick, D. D. Jensen, E. O. Essig, A. E. Michelbacher, R. C. Miller, G. F. Ferris, O. B. Cope, H. P. Chandler, J. F. Gustafson, C. W. Grant, B. D. Culver, F. E. Skinner, E. S. Dethlefsen, W. L. Lee, F. J. Driver, E. A. Smith, J. P. Harville, R. A. Flock, R. W. L. Potts, G. E. Bohart, E. G. Linsley, R. F. Smith, J. W. MacSwain, W. W. Sampson, K. S. Hagen, W. F. Barr, H. T. Reynolds, D. J. Raski, C. D. Duncan, and E. S. Ross. Visitors were present as follows: W. A.

Russell, Mrs. W. Hart, Mrs. F. M. Frick, R. L. Doutt, L. S. Miller, L. M. Henry, P. H. Arnand, R. W. Coleman, D. Guiliani, A. W. Larson. W. H. Nutting, R. Van den Bosch, G. Markos, R. F. Portman, J. E. Ryus, D. P. Furman, and A. E. Pritchard.

The minutes of the previous meeting and the treasurer's financial statement were read and approved.

The nominating committee proposed, and the Society elected, the following Officers for 1947: E. L. Kessel, President; A. E. Michelbacher, Vice-President; E. S. Ross, Secretary; R. C. Miller, Treasurer: and G. F. Ferris, Member-at-large, Executive Committee.

The membership committee proposed the following for membership in the Society: T. O. Thatcher, R. L. Doutt, A. E. Pritchard, A. W. Larson, W. H. Nutting, and W. A. Russell. They were unanimously elected.

As chairman of the nomenclature committee, Prof. Ferris read a petition signed by members of the Committee on Zoological Nomenclature of the Smithsonian Institution which requests that the United Nations Educational, Scientific, and Cultural Organization give favorable consideration to Secretary Hemming's proposal for adequate financial support for the International Commission on Zoological Nomenclature. Prof. Ferris then moved that the Society endorse this petition. The motion was seconded and unanimously passed.

President Duncan appointed R. W. L. Potts Chairman and J. W. MacSwain and W. F. Barr members of a committee to audit the financial accounts of the Society.

The frequency of meetings was discussed and Dr. Usinger moved that the number of meetings be increased to four Spring meetings and two Fall meetings. The motion was carried unanimously.

In response to a call for notes and exhibits, Miss Henry spoke on her study of the innervation of the heads of Annelida and arthropods and its value in the interpretation of the segmentation of the insect head. Her remarks were illustrated by a display of her fine drawings.

Mr. MasSwain reported on his success in collecting Protura in the Berkeley Hills on rotting twigs deep in the litter under bay trees (*Umbellularia californica*).

Dr Ross called attention to his recent discovery of *Dinapate wrightii* in palms southwest of El Mante, Tamaulipas, Mexico. This spectacular beetle was at one time believed to be endemic to California.

Because of Dr. Kessel's absence, President Duncan turned the meeting over to the newly elected Vice-President, Dr. Michelbacher, who introduced the new officers and presided during Dr. Duncan's retiring presidential address entitled "Insects and Human Welfare." (This address is published in full in the present issue of the Pan-Pacific Entomologist). After a brief discussion of the paper, the meeting adjourned.—E. S. Ross, Secretary.